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L3: Entry 16 of 18

File: USPT

May 19, 1992

DOCUMENT-IDENTIFIER: US 5115463 A  
TITLE: Extended cordless telephone system

Brief Summary Text (20):

The plurality of transmitters has each transmitter responsive to a control signal from the control processor for transmitting the packet data signals as communication data signals. The communication data signals may use phase shift keying, frequency shift keying, or other techniques which may be employed for transmitting data. The transmitter frequency hops, transmitting the packet data signals on a plurality of frequencies.

Brief Summary Text (23):

The second embodiment of the present invention may additionally include a second plurality of receivers coupled through the receiver multicoupler. The second plurality of receivers monitors the plurality of frequencies on which the plurality of transmitters frequency hop, transmitting the communication data signals. In response to detecting an interfering signal, which is interfering on at least one of the plurality of frequencies, the second plurality of receivers generates a nonavailability signal, which includes information of the frequency of the interfering signal. The nonavailability signal is sent to the control processor. In response to the nonavailability of the signal, the control processor reassigns the frequency with the interfering signal at the plurality of transmitters to a noninterfered frequency with no interference, of the plurality of frequencies. This reassignment changes the frequency with the interfering signal to the noninterfered frequency in the plan for frequency hopping for the plurality of transmitters.

Detailed Description Text (13):

The power divider 160 is constructed using essentially the same technology as power combiner 156. As a power divider, the power divider 160 has a plurality of divider ports, and an input port. The power divider 160 has included therein a plurality of divider striplines with each stripline transforming a first impedance of a first port by a ratio of approximately 2:1 to a second impedance of a second port. The impedance ratios of each divider stripline might be 100 OHMS from the first port to 50 OHMS at the second port. Preferably the plurality of divider striplines are connected with at least a first port of a first divider stripline and a first port of a second divider stripline connected in parallel to the antenna port of duplexer 158. The input impedance of the first port of the first divider stripline and the second divider stripline are each 100 OHMS. Accordingly, the parallel combination of the input ports of the first and second divider striplines is 50 OHMS which matches the preferable impedance, 50 OHMS, of the antenna port of duplexer 158. Additional divider striplines can be connected to the output of the first and second divider striplines in a similar manner to increase the number of output ports of power divider 160. In a transmit mode, the power divider 160 operates to divide power from the plurality of transmitter modules among the plurality of radiax cables. In a receive mode the power divider 160 operates to combine power from the plurality of radiax cables through the duplexer to the receiver multicoupler.

Detailed Description Text (50):

The present invention may include a second plurality of receivers which is coupled through a second receiver multicoupler to the duplexer. The second plurality of receivers monitor the plurality of frequencies on which the plurality of ACSB transmitter modules transmits and the first plurality of receivers receives the communications signals. In the event an interfering signal is detected on one of the plurality of frequencies, then the receiver of the second plurality of receivers which detects the interfering signal, generates a nonavailability signal. The

control processor reassigns the frequency with the interfering signal at the corresponding transmitter module and at the remote units, to a frequency with no interference, of the plurality of frequencies. The control processor does this in response to receiving the nonavailability signal from the receiver of the second plurality of receivers detecting the interfering signal. The control processor reassigns the frequency at the remote unit by sending information on the reassigned frequency through a control signal.

Detailed Description Text (54):

In response to a control signal from the control processor, each data transmitter transmits the packet data signals as communication data signals. Each data transmitter transmits by frequency hopping on a plurality of frequencies. A packet data signal is transmitted on each frequency. The communication data signals may use any well known type of modulation for data signals, including phase shift keying, frequency shift keying, and other combinations and modulation types thereof.

Detailed Description Text (57):

A second plurality of receivers is also included, and is coupled through a receiver multicoupler to the duplexer. The second plurality of receivers monitors the plurality of frequencies on which the plurality of data transmitters hops and transmits and the plurality of remote units hops and receives the data-communication signals. In the event an interfering signal is detected on at least one of the plurality of frequencies, then the receiver of the second plurality of receivers which detects the interfering signal, generates a nonavailability signal. The control processor reassigns the frequency with the interfering signal at the plurality of transmitters and at the remote units, to a frequency with no interference, of the plurality of frequencies. The control processor does this assignment in response to receiving a nonavailability signal from the receiver of the second plurality of receivers detecting the interfering signal. The control processor reassigns the frequency hopping frequency at the remote units by sending information on the reassigned frequency through the control data signal.

CLAIMS:

1. An extended phone service system for communicating information signals from a plurality of telephone lines through a telephone exchange to a plurality of remote units, comprising:

central station communicating signals to and from the plurality of telephone lines, said central station including,

a plurality of transceivers for transmitting and receiving the information signals as amplitude companded sideband (ACSB) signals;

a power combiner coupled to said plurality of transceivers, said power combiner including a plurality of combiner striplines with each combiner stripline transforming an input impedance by a ratio of 1:2 to an output impedance, said plurality of combiner striplines connected for combining the ACSB signals outputted from said plurality of transceivers with impedance matching to an output of said power combiner, by having at least an output of a first combiner stripline and an output of a second combiner stripline coupled to an input of a third combiner stripline,

a duplexer, with a transmitter port coupled to the output of said power combiner, with a receiver port coupled to said plurality of transceivers, and with an antenna port;

a power divider with a first port coupled to the antenna port of said duplexer, and a plurality of divided ports, said power divider including a plurality of divider striplines with each stripline transforming a first port impedance by a ratio of 2:1 to a second port impedance, said plurality of divider stripline connected with at least a first divider stripline with a first port coupled to the antenna port of said duplexer and a second port coupled to a first port of a second divider stripline and a first port of a third divider stripline;

a plurality of isolators coupled between each of said transceivers and each of said combiner striplines coupled to each of said transceivers, respectively, for isolating power outputted from said transceivers;

a plurality of linear amplifiers coupled between each of said transceivers and each of said isolators coupled to each of said transceivers, respectively, for amplifying power outputted from said transceivers; and

a plurality of radiax cables coupled to said plurality of divided ports for radiating the ACSB signals to and receiving the ACSB signals from said plurality of remote units.

8. The extended phone service system as set forth in claim 4, further comprising:

a plurality of linear amplifiers with each of said plurality of linear amplifiers coupled between each of said transmitter means and each of said isolator means coupled to each of said transmitter means, respectively, for amplifying power outputted from said transmitter means.

10. An extended phone service system for communicating digital-information signals from a plurality of communication lines to a plurality of remote units, comprising:

a control processor;

packet means for generating packet data signals from a plurality of digital-information signals and a control data signal;

a plurality of transmitter means, each transmitter means responsive to a control signal from said control processor for transmitting and frequency hopping on a plurality of frequencies, the packet data signals as communication data signals;

a power combiner coupled to said plurality of transmitter means, said power combiner including a plurality of combiner striplines connected for combining power outputted from said plurality of transmitter means to an output of said power combiner;

a plurality of isolators coupled between each of said transmitters and each of said combiner striplines coupled to each of said transmitters, respectively, for isolating power outputted from said transmitters;

a plurality of high Q filters coupled between each of said transmitters and each of said isolators coupled to each of said transmitters, respectively, for filtering power outputted from said transmitters; and

at least one radiax cable coupled to the output of said power combiner for radiating the frequency hopping signals to said plurality of remote units.

11. The extended phone service system as set forth in claim 10, further comprising:

a first plurality of receivers for receiving remote-data signals transmitted from said remote units;

a duplexer, with a transmitter port coupled to the output of said power combiner, with a receiver port coupled to said plurality of receivers, and with an antenna port coupled to said radiax cable; and

a second plurality of receivers for monitoring the plurality of frequencies, and responsive to an interfering signal interfering on at least one of the plurality of frequencies, for generating a nonavailability signal; and

wherein said control processor, responsive to the nonavailability signal, reassigns the frequency with the interfering signal at the plurality of transmitter means to a noninterfered frequency with no interference, of the plurality of frequencies.

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L5: Entry 1 of 2

File: USPT

Dec 20, 1983

DOCUMENT-IDENTIFIER: US 4422047 A

TITLE: Solid state autotune power amplifier

Abstract Text (1):

A solid state, band-pass filtered, RF power amplifier for equalizing the response of an amplified RF signal across the entire tuning range of a multi channel transmitter is disclosed. An RF signal is applied to the input of a low noise FET amplifier with a portion of the signal coupled off into a frequency counter which in conjunction with a digital switching logic selects a path through a band-pass filter having characteristics that reduce the broadband noise of the RF signal passed therethrough. Additionally, a dual directional coupler samples the output of the power amplifier with the forward sampled signal being used to control the amplifier output to a preselected level and the reverse sampled signal being used to reduce the amplifier output signal in proportion to an increase in the voltage standing wave ratio load between the amplifier and the transmit/receive switch.

Brief Summary Text (5):

Additionally, automatic switching has been utilized to match the output impedance of transmitter circuits to that of a particular antenna. Again, these are generally directed to electromechanically varying the capacitance or inductance or by electromechanically inserting fixed parameter capacitors and inductors to form a specific LC network circuit between the output of a power amplifier and an antenna transmit/receive switch.

Detailed Description Text (10):

Capacitors 88 and 90 are connected in-line to isolate band-pass filter BPF-1 by preventing the +V DC voltage from being impressed there across. Additionally, radio frequency chokes 92 and 94 are provided in each BPF-N select lines to prevent the RF signal coupled into the selected BPF from feeding back into the decoder/driver 52. As above mentioned, the select operation for any particular band-pass filter is the same, with only the band-pass characteristics of each circuit 62 being different.

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L8: Entry 10 of 15

File: USPT

Dec 13, 1988

DOCUMENT-IDENTIFIER: US 4791426 A

**\*\* See image for Certificate of Correction \*\***

TITLE: Active antenna in the rear window of a motor vehicle

Abstract Text (1):

An active antenna for the reception of long-, medium-, short-and ultra-short wave broadcasts is arranged in a rear window of a motor vehicle equipped with a boundary conductor enclosing an array of heating elements. The reception of long-, medium- and short-wave signals is made by means of an elongated flat antenna element which is arranged in the window on a free area above or below the heating elements, and the reception of the ultra-short wave signals is effected by the array of heating elements. An antenna amplifier includes a linear amplifying stage connected to the flat antenna element, an amplifying branch circuit connected to the array of heating elements and a common ground terminal connected to the boundary conductor. A frequency separator has two inputs connected, respectively, to the output of the amplifying stage and of the branch circuit, and an output connected via an antenna cable to a conventional radio receiver.

Brief Summary Text (2):

The present invention relates in general to an active antenna for the reception of long, medium, short and ultra-short wave broadcasts and being mounted on an electrically heated rear window of a motor vehicle. The heated rear window is equipped with a set of heating elements connected via bus bars to direct current power connections and including also connections to an antenna amplifier.

Brief Summary Text (11):

In keeping with these objects and others which will become apparent here after, one feature of this invention resides, in an antenna system arranged in a heated rear window of a motor vehicle provided with a boundary conductor and a set of heating elements connected via bus bars to direct current power connections, in the provision of an elongated, flat antenna element mounted in the window between the set of heating elements and the boundary conductor to receive long, medium and short wave signals, the flat antenna having a transverse dimension which is adjusted for optimizing recieved signals; a low noise linear amplifier of a high capacitive input impedance, the amplifier including a first amplifying stage for the long, medium and short wave signals, a second signal processing stage for ultra-short wave signals, and a common ground terminal, an input of the first stage being connected to the flat antenna element by a short conductor and the common ground terminal being connected by another short conductor to the boundary conductor; a frequency separator having two inputs connected respectively to outputs of the first and second amplifier stages, and an output connected to an antenna connector; and means for coupling an input of the second amplifier stage to a conductor in the window acting as an antenna element for the ultra-short wave signal. The input of the second amplifying stage is connected to one end of the bus bar of the heating elements and the coupling means include a reactance circuit passing through direct current and connected to the other end of the bus bar and the connection for the direct current supply. In a modification the input of the second amplifying element is coupled to the elongated flat antenna element.

Detailed Description Text (4):

In the long-medium-short range the antenna can be represented as a source with a capacitive internal resistance  $1/C_a$  in series with a frequency independent source voltage  $E.h.sub.eff$ . In disregarding the capacity of connectors between the antenna element and the input of the corresponding long-medium-short wave amplifying stage, the capacity of the antenna  $C_a$  is combined at the input 5 with the overall

capacities  $C_v$  of the antenna amplifier as shown in FIG. 9. At a given internal noise voltage  $U_r$  of the amplifier, the required minimum field strength  $E_g$  for a signal-noise ratio of 1 is determined as follows:

Detailed Description Text (10):

For a control voltage  $U_e$  at the input of the L-M-S antenna amplifier stage, there results from the afore described equation (2) relationships illustrated in FIG. 12. With increasing width  $h$  of the area of the window which is not covered by the set of heating elements the maximum achievable control voltage also increases. Independently from the absolute value of the  $h$  there is always for the same value of  $b/h$   $(b/h)_{opt}$  a maximum control voltage  $U_{sub.emax}$ . The value  $(b/h)_{opt}$  depends on the input capacity  $C_v$  of the L-M-S wave stage of the antenna amplifier. The approximately parabolic characteristic of the course of  $U_e/U_{ref}$  as a function of  $b/h$  can be described with a sufficient accuracy for the range of 5 pF less than  $C_v$  less than 100 pF, and 0.05 less than  $b/h$  less than 0.95, by the following equation:

Detailed Description Text (13):

The dimensions of the set of heating elements and the position thereof in the rear window of the vehicle are determined by the design of the particular motor vehicle. As a rule, there remains only a narrow free area on the window surface which is available for mounting the L-M-S range antenna element. Accordingly, it is necessary to make use of the maximum dB value in order to improve the signal to noise ratio. To meet this requirement, apart from the optimization of the width  $b$  or of the clearance  $a$  in accordance with this invention it is also required to employ an antenna amplifier having a small total input capacity  $C_v$  and avoiding any additional capacitive loads. Accordingly, the connection conductors between the connection point on the L-M-S antenna element 4 and the input terminal of the L-M-S amplifying stage must be made as short as possible.

Detailed Description Text (19):

The input of a separate amplifying stage 13 for very short wave length signals in the antenna of this invention is connected either to the connection point 19 on one of the bus bars of the set of heating elements 24 (FIG. 1) or the very short wave signal can be also coupled to the flat antenna element for L-M-S wave reception (FIGS. 4a, 4b). The common ground terminal 22 of the antenna amplifier 23 is to be connected to the conductive boundary of the rear window in close proximity to the connection point 19 or 4 so as to obtain well-defined impedances and quality in the ultra-short wave circuit.

Detailed Description Text (20):

In coupling the ultra-short wave amplifying stage 13 to the set of heating elements it is of advantage when the heating elements, due to the fact that they occupy a relatively large surface, be strongly coupled to the ultra-short wave field. Moreover, the input of the amplifier stage 13 should have a relatively low broad band impedance so as to ensure a loss-free transformation. The properties of the amplifier stage 4 contribute to better results in a high quality reception.

Detailed Description Text (28):

The technological expenditures resulting from the necessity to employ one or two reactance networks in the direct current supply conduits for the set of heating elements can be avoided when the input of the ultra-short wave signal amplifier 13 is not connected to the bus bar for the heating element but is coupled to the flat antenna element for L-M-S wave range which is also excited by the ultra-short wave field. This coupling can be for example a capacitive one (FIG. 4a) whereby the unavoidable capacity  $C_k$  20 connected parallel to the L-M-S-amplifying stage contributes to the increase of the overall capacity  $C_v$  of the amplifier. Therefore, this parallel capacity  $C_k$  20 is to be held as low as possible in order to prevent the deterioration of the L-M-S reception.

Detailed Description Text (32):

In the preferred embodiment of this invention the ultra-short wave stage 13 in the antenna amplifier 23 is an active element which in comparison with an exclusively passive circuit has a substantially improved signal to noise ratio of the entire system. It is also necessary that the amplifying stages be matched to the inner impedance of the ultra-short wave antenna structure by means of a low-loss

transforming circuit so as to optimize the signal to noise ratio and that the amplifier be situated in close proximity to the connection points to the antenna elements. This possibility of improving the average distance between the signal and noise is particularly advantageous when the operational efficiency of the passive antenna elements in comparison to a reference antenna, for example to a standard rod antenna, is not sufficient. A further low-loss transforming circuit at the output of the active element in the ultra-short wave signal stage 13 makes it possible to match efficiency in the ultra-short wave band to the characteristic impedance of the connection cable to the receiver.

Detailed Description Text (33):

In order to achieve an economic design, in the case of a satisfactory efficiency of the passive ultra-short wave antenna element it is advantageous when the signal stage 13 for ultra-short wave range is constructed exclusively of low-loss passive transforming elements to match the impedance of the ultra-short wave antenna structure to the characteristic impedance of the cable.

Detailed Description Text (34):

In the embodiment of the antenna of this invention in which for the reception both of the L-M-S wave signals and ultrashort wave signals a common flat antenna element 3 is used, the connection point 4 can be located at an arbitrary point of the antenna element, for example at the intersection of the antenna element 3 with a vertical axis of symmetry 30 of the conductive boundary of the window. As a rule, it is more advantageous when the connection point 4 is located at the right or left narrow side of the flat antenna element inasmuch as a shorter connection cable results and in addition in the proximity to the narrow sides of the antenna element a better accommodation of the antenna amplifier 23 in the frame of the car is possible (FIG. 2).

Detailed Description Text (35):

If for the reception of ultra-short wave signals the heating structure is employed as an antenna element, it is advantageous when the connection point 19 on the bus bar of the heating structure 2 and the connection point 4 on the flat antenna element 3 are situated in close proximity to the conductive rim of the window either at the left narrow side or at the right narrow side of the window pane (FIG. 1). In this manner short connections between the point 4 and the input of amplifying stage 6 or between the point 19 and the signal processing stage 13 are made possible. The amplifying stage 6 for L-M-S wave signals and the signal processing stage 13 for ultra-short wave signals are connected to corresponding inputs of a frequency separating circuit 11 whereby the circuits 6, 13 and 11 are preferably accommodated in a common housing of the antenna amplifier 23 and the common ground connection of the amplifier 23 is also preferably located in the proximity of connection points 4 and 19 at the conductive boundary of the window.

Detailed Description Text (36):

In many instances the distance between the heated field and the rim of the window is too small for obtaining a minimum field strength (FIG. 12). For example, a reduction in width  $h$  of the free strip-shaped area of the window from 20 centimeters to 6 centimeters even at the optimum dimensioning of the antenna element of this invention leads to a reduction of about 10.5 dB of the signal to noise ratio in the L-M-S wave range. In such cases an improvement of the limit sensitivity is achieved when the heating field is separated for high frequencies also in the L-M-S wave range from the direct current power supply in such a manner that a bifilar choke 30 is connected to the direct current supply wires (FIG. 8). In this embodiment the set of heating elements delivers a signal voltage at the L-M-S wave frequency with respect to the surrounding body of the motor vehicle. The equivalent circuit according to FIG. 9 of the antenna with the amplifier remains unchanged. The minimum limit field strength  $E_g$  however is not obtained for the same clearances  $a_k$  and  $a_h$  (FIG. 2). Due to the contribution of the heating structure to the reception and its capacitive coupling to the L-M-S wave antenna element 3, a substantially smaller clearance  $a_h$  to the heating field than the clearance  $a_k$  to the conductive rim of the window is needed for achieving minimum field strength  $E_g$  or the maximum voltage  $U_{sub.e}$ .

CLAIMS:

1. An active antenna arranged in an electrically heated rear window of a motor vehicle to receive long-, medium-, short-, and ultra-short wave broadcasts, said rear window having a boundary conductor and a set of heating elements connected via bus bars to direct current power connections, said antenna comprising

an elongated, flat antenna element arranged in the window on a free area between said set of heating elements and said boundary conductor to receive long-, medium-, and short wave signals;

an antenna amplifier including a linear amplifying stage having a capacitive input connected to said flat antenna element for processing long-, medium- and short-wave signals, a branch circuit for processing ultra-short wave signals having an input coupled to said set of heating elements in said window acting as an antenna element for the reception of said ultra-short wave signals, and a common ground terminal connected to said boundary conductor; and

a frequency separating circuit having two inputs connected respectively to outputs of said amplifying stage and of said branch circuit to separate said long-, medium- and short-wave signals from said ultra-short wave signals and an output connected to a connector for an antenna cable.

16. An active antenna as defined in claim 1, wherein said set of heating elements includes horizontally oriented heating wires delimiting a substantially rectangular free area with a clearance  $h$  to the opposite horizontal side of the window, said flat antenna element extending in the central region of said free area, the elongated sides of the flat antenna element being clear of said opposite horizontal side of the window and of the set of heating elements by distances  $a_k$  and  $a_h$ , the narrow sides of the flat antenna element being clear of the opposite vertical sides of the window by distances  $a_s$ , said distances being equal to each other and at a given input capacity  $C_v$  of the antenna amplifier in the range between 5 and 100 pF being approximately determined by the equation

$a_k = a_h = a_s = a_{\text{sub.opt}} \approx h/2 \cdot [0.7 - 0.1 \cdot \log_2 (C_v/10\text{pF})]$

wherein  $\log_2$  is a logarithm at the base of 2.

19. An active antenna as defined in claim 1, wherein the elongated flat antenna element is assembled of a plurality of parallel elongated conductors interconnected at the ends thereof which are connected to the amplifier stage while the opposite ends of the parallel conductors are disconnected.

21. An active antenna as defined in claim 1, wherein said branch circuit for processing ultra-short wave signals has an input which is capacitively coupled to said elongated flat antenna element, said capacitive coupling having a relatively small capacity with respect to the input capacity  $C_v$  of the amplifier so as to avoid any impairment of reception in the L-M-S wave range due to excessive capacitive loads.



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L12: Entry 24 of 31

File: USPT

Oct 9, 1984

DOCUMENT-IDENTIFIER: US 4476578 A

TITLE: Device for detecting the optimum anode load impedance of a tube transmitter in a high frequency transmission chain

## CLAIMS:

1. A device for detecting the optimum anode load impedance of a transmitter tube in a high frequency transmitting chain, this transmitting chain comprising besides the tube, a transmitting antenna, the device comprising a variable impedance matching cell interposed between the tube and the transmitting antenna, said cell detecting said optimum anode load impedance of said tube, by detecting, from an input and an output voltage of said tube, during the variation of the impedance presented to said anode of said tube by said matching cell, a passing of said anode load impedance through a pre-determined purely resistive value; said cell comprising means for phase shifting by  $k(\pi/2)$  (with  $k$  being a positive or negative uneven integer) the phase difference between said input and output voltages of said tube, means for multiplying by each other the two voltages thus processed, and means for calculating the mean value of the product thus obtained, and for cancelling this mean value, during the variation of the impedance matching cell corresponding to the passing of the anode load impedance through a purely resistive value.

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L2: Entry 3 of 3

File: USPT

Dec 20, 1983

DOCUMENT-IDENTIFIER: US 4422047 A

TITLE: Solid state autotune power amplifierAbstract Text (1):

A solid state, band-pass filtered, RF power amplifier for equalizing the response of an amplified RF signal across the entire tuning range of a multi channel transmitter is disclosed. An RF signal is applied to the input of a low noise FET amplifier with a portion of the signal coupled off into a frequency counter which in conjunction with a digital switching logic selects a path through a band-pass filter having characteristics that reduce the broadband noise of the RF signal passed therethrough. Additionally, a dual directional coupler samples the output of the power amplifier with the forward sampled signal being used to control the amplifier output to a preselected level and the reverse sampled signal being used to reduce the amplifier output signal in proportion to an increase in the voltage standing wave ratio load between the amplifier and the transmit/receive switch.

Brief Summary Text (2):

This invention relates to RF Power Amplifiers, and more particularly to a solid-state, band-pass filtered, RF power amplifier with autotune capabilities for providing equal response across the entire RF spectrum covered by a plurality of transmission channels of a radio transmitter.

Brief Summary Text (5):

Additionally, automatic switching has been utilized to match the output impedance of transmitter circuits to that of a particular antenna. Again, these are generally directed to electromechanically varying the capacitance or inductance or by electromechanically inserting fixed parameter capacitors and inductors to form a specific LC network circuit between the output of a power amplifier and an antenna transmit/receive switch.

Brief Summary Text (6):

In those instances where attention has been directed to tuning the power amplifier for band-pass filtering, the tunable filter has, in general, been designed around a three gang variable inductor and a band select switch which is incorporated as part of the accompanying transmitter. The tuning of these components is controlled by mechanical linkages which permitted sufficient filtering to enable the equipment to be set up for re-transmission and co-located operation.

Brief Summary Text (8):

Accordingly, there is a need for a solid state automatically tunable power amplifier which will provide very selective filtering across a multi Megahertz range to reduce broad band noise to a level that will permit re-transmission and co-located operation of the transceiver. Additionally, to enhance equalization of the output signal across the spectrum covered by the multiple channels of the transmitter, a requirement exists for an automatic level control which controls the output of the power amplifier to a preset level and reduces the output power there if in relation to an increase in the voltage standing wave ratio (VSWR) load of the system.

Brief Summary Text (10):

The present invention is directed to a solid state, automatic tuning, RF power amplifier designed for use in connection with multi channel radio transmitters covering multiple Megahertz ranges.

Brief Summary Text (11):

In accordance with preferred embodiment of the invention, a transmitter output

frequency is detected and used to switch a power band pass filter specific for the detected frequency into the power amplifier circuit. Coupling the detected frequency through the selected filter eliminates broad band noise prior to amplification thereof. More specifically, the RF input to a low noise FET amplifier is sampled by an isolated frequency counter, the output of which is used to switch an appropriate bandpass filter into the power amplifier circuit as well as to switch the output of the amplifier into a low pass filter above a pre-determined frequency to prevent harmonic interference adjacent high frequency signal circuits. The output of the low noise FET amplifier is coupled through the selected bandpass filter and into a pushpull power amplifier. The amplified signal is in turn coupled into a transmit/receive switch. Forward and reverse feedback signals are coupled off of the amplified signal outputed and coupled into an output level control which controls the amplification of the low noise FET amplifier in functional relation to a preselected output level and a voltage standing wave ratio load. Additionally, a selectable low power output mode of operation is provided in the embodiment.

Drawing Description Text (3):

FIG. 1 is a block diagram illustrating the transmit circuit of a typical transceiver and employing the autotune power amplifier of the present invention.

Drawing Description Text (4):

FIG. 2 is a block diagram of the autotune power amplifier of the present invention;

Drawing Description Text (5):

FIG. 3 is a block diagram of the frequency logic circuit of the autotune power amplifier of the present invention, including a schematic representation of the solid state band-pass filter switching logic;

Drawing Description Text (7):

FIG. 5 is a partially in schematic block diagram illustrating the VSWR and level control circuit of the autotune power amplifier of the present invention; and

Drawing Description Text (8):

FIG. 6 is a schematic representation of a typical low pass filter circuit in a cascaded network configuration utilized in connection with the autotune power amplifier of the present invention.

Detailed Description Text (2):

The present invention is directed to automatically tuning a power amplifier to provide equal response across all channels of a multichannel high frequency radio transmitter. By detecting the RF signal frequency of the transmitter, a band pass filter having characteristics matched to the RF signal frequency may be automatically selected from a number of band pass filters, each having separate characteristics which collectively cover the multiple Megahertz bandwidth of all channels of the radio transmitter. The selected filter is automatically inserted into the power amplifier with the RF signal being coupled through the filter to reduce broadband noise and aid in equalizing the response across the filter.

Detailed Description Text (3):

Additionally, a control signal is derived from the output of the power amplifier and used to maintain a preselected signal level output and to provide for a reduced power output upon the occurrence of an increase in the voltage standing wave ratio (VSWR) load of the transmitter circuit.

Detailed Description Text (4):

Referring now to FIG. 1, there is shown the transmitter section of a multichannel radio transceiver 10. Transmitter 12 provides selective tuning to permit generation of an RF carrier signal falling within a multiple megahertz bandwidth capability of the transmitter. The RF signal is coupled via conductor 20 into the input of a power amplifier 14 where the signal is amplified and then coupled via conductor 22 into a transmit/receive switch 16 which, during the transmit mode of operation, couples the amplified RF signal into an antenna 18 for transmission.

Detailed Description Text (5):

As will be hereinafter described in greater detail, a frequency detection and

switching logic circuit 24 is interconnected to power amplifier 14 to permit the automatic frequency detection and accompanying automatic band-pass filter switching forming a portion of the present invention. Referring also the FIG. 2, transmitter 12 is operated to generate an RF signal at a preselected frequency. This signal is coupled into power amplifier 14 via conductor 20 which passes through RF coupler 26. A portion of the RF signal is coupled off from conductor 20 by RF coupler pick-up 27 and inputted into buffer 28 which provides gain for the coupled RF signal and isolation to prevent spurious signals and noise from coupling back through RF coupler 27 to interfere with the RF signal present on conductor 20. The RF signal outputted from buffer 28 is coupled into a frequency counter 30. Referring also to FIG. 3, the RF signal from buffer 28 is coupled through a signal conditioning circuit 32 into one input of a digital gate 34. A time base oscillator 36 generates a fixed clock signal which is coupled into time base divider 38 to provide the necessary clock timing for operation of the frequency timer 30. A clock signal is then coupled from divider 38 to the remaining input of gate 34 through main gate flip-flop 40. The clock signal applied on gate 34 acts to step the RF signal through into counting register 42, where each frequency cycle increment the count 42 in a predetermined manner, to provide a digital count signal functionally related to the RF frequency signal.

Detailed Description Text (9):

Upon decoding the BPF address from ROM 44, the driver section of decoder/driver 52 selects the addressed lines, driving them to a low state. As decoder/driver 52 drives band-pass filter select line 54 (BPF-1 select) to a low state, a +V/dc voltage signals acts through resistors 84 and 86 to produce a forward bias current respectively through pin diodes 80 and 82 at the input and output respectively of band pass-filter BPF-1. This bias current creates a low resistance or ON state driving pin diodes 80 and 82 into conduction, which permits the RF signal inputted on conductor 72 to be coupled into band-pass filter BPF-1 via pin diodes 80 and across capacitor 88. The RF signal is outputted from BPF-1 across capacitor 90 and, via pin diode 82, into a V-MOS push-pull amplifier 102.

Detailed Description Text (11):

Referring again to FIG. 2, the filtered RF signal is coupled into a V-MOS push pull amplifier 102 for amplification of the signal to a preselected level. The amplified signal is then coupled via conductor 104 through a dual directional coupler 110.

Detailed Description Text (13):

V.sub.F is functionally related to the output power and is coupled into one input of a different amplifier 120. V.sub.f is used to control the magnitude of the RF signal power outputted from power amplifier 14 in the following manner. A resistance network 122 containing a potentiometer 124 provides a means by which a DC reference voltage (+V) may be developed and coupled into the remaining input of differential amplifier 120. During operation, potentiometer 124 is adjusted to produce, in conjunction with V.sub.F, a voltage signal which is functionally related to the power of the RF signal outputted from power amplifier 14.

Detailed Description Text (14):

The differential amplifier 120 output signal is coupled into the second stage 73 of low noise FET amplifier 70. This signal sets the level of amplification within amplifier 70 to produce a output signal having a magnitude sufficient to produce the desired power amplifier output signal magnitude. Any increase or decrease in the output signal of differential amplifier 120 results in a respective increase or decrease in the gain of FET amplifier 70.

Detailed Description Text (15):

The V.sub.R signal is proportional to the reverse power sensed in coupler 110 and is a measure of the voltage standing wave ratio (VSWR) load of transmitting system 10. V.sub.R is coupled into the same input port of differential amplifier 120 as is the V.sub.F signal. In operation, as the VSWR decreases the DC voltage V.sub.R increases, causing a decreased signal output from differential amplifier 120. This decreased output causes a decrease in the amplification of FET amplifier 70. This results in a reduced power output of the power amplifier 14, which reduction is proportional to the increase in the VSWR load of the circuit 10. By thus decreasing the power output of circuit 10 in response to increasing VSWR, the operational

stability of the circuit is enhanced.

Detailed Description Text (16):

Additionally, at times it is desired to operate the transmitter system in a reduced power mode. Accordingly, a low-power select control 130 incorporating a switch 132 is included. As determination of the power output mode is a function of selection in transmitter 12, switch 132 may be the contacts of a relay contained within transmitter 12 which, when energized, directs a portion of the DC voltage level developed across resistance networks 122 through a resistance 133 to ground. This grounding of a portion of the DC reference signal decreases the voltage signal inputted into differential amplifier 120, with an accompanying decrease in the control signal applied to second stage 73 of FET amplifier 70 and with an attendant reduction in power outputted from power amplifier 14.

Detailed Description Text (17):

Additionally, for frequencies in excess of 50 megahertz an additional filter 146 is included to provide filtering for low band-pass frequencies which can create harmonic interference to communications in other operating system above 100 megahertz. Referring now to FIGS. 2 and 3, the read only memory (ROM) 44 of frequency counter 30 provides an output via conductor 138 which is coupled into low pass filter switch logic 140. Switch logic 140 detects when the frequency count reaches 50 megahertz and operates switch 144 to insert a low pass filter 146 (refer to FIG. 6 for a typical low pass filter circuit configuration) between the output of power amplifier 14 and transmit/receive switch 16. Although not shown in detail, it is envisioned that a typical embodiment of switch 144 will incorporate a pin diode switch arrangement similar to that as above described for operation of the pin diode switches 80 and 82 contained in the band-pass filter select circuits.

Detailed Description Text (18):

While certain types of logic have been described herein by way of example, it is understood that the actual hardware used will be dictated by operating frequencies, power requirements, and characteristics of the system in which the power amplifier is to be used.

CLAIMS:

1. A method of automatically tuning an R.F. power amplifier to the R.F. signal generated in a multichannel radio transmitter and applied to the input of the R.F. power amplifier so as to provide equal response across all transmission channels of the radio transmitter, comprising the steps of:

- (a) determining the frequency of the R.F. signal;
- (b) automatically selecting one of a plurality of band pass filters (BPF) having separate band-pass characteristics which collectively cover the bandwidth of all channels of the radio transmitter, basing said selection on said frequency determination;
- (c) passing the RF signal through said selected BPF for reducing broadband noise;
- (d) amplifying said filtered RF signal to a preselected level;
- (e) sampling said amplified and filtered RF signal; and
- (f) controlling the magnitude of said amplified and filtered RF signal with said sample and in functional relation to said preselected level and a Voltage Standing Wave Ratio (VSWR) load of the RF power amplifier.

4. The method of claim 1, wherein said step of sampling said amplified and filtered RF signal further comprises the steps of:

- (a) sampling said amplified and filtered RF signal in a forward direction with respect to the RF signal path
- (b) developing a first dc voltage level proportional to the magnitude of said

forward sampled RF signal;

(c) sampling said amplified and filtered RF signal in a reverse direction with respect to the RF signal path;

(d) developing a second dc voltage level proportional to the magnitude of reverse current caused by said VSWR load of the RF power amplifier;

(e) providing a dc reference voltage level;

(f) comparing said first dc voltage level with said dc reference voltage level for developing a first differential control signal for controlling the magnitude of said amplified and filtered RF signal at said preselected level; and

(g) comparing said second dc voltage level with said dc reference voltage level for developing a second differential control signal for reducing the magnitude of said preselected level in response to an increase in said VSWR load of the RF power amplifier.

5. The method of claim 3, wherein said step of sampling said amplified and filtered RF signal further comprises the steps of:

(a) sampling said amplified and filtered RF signal in a forward direction with respect to the RF signal path;

(b) developing a first dc voltage level proportional to the magnitude of said forward sampled RF signal;

(c) sampling said amplified and filtered RF signal in a reverse direction with respect to the RF signal path;

(d) developing a second dc voltage level proportional to the magnitude of reverse current caused by said VSWR load of the RF power amplifier;

(e) providing a dc reference voltage level;

(f) comparing said first dc voltage level with said dc reference voltage level or developing a first differential control signal for controlling the magnitude of said amplified and filtered RF signal at said preselected level; and

(g) comparing said second dc voltage level with said dc reference voltage level for developing a second differential control signal for reducing the magnitude of said preselected level in response to an increase in said VSWR load of the RF power amplifier.

6. An automatically tuned, solid-state R.F. power amplifier responsive to an R.F. signal generated in a multichannel radio transmitter to automatically tune the amplifier to provide equal response across all channels of the radio transmitter, comprising:

(a) means for determining the frequency of an RF signal inputted into the RF power amplifier;

(b) means responsive to said frequency determining means for automatically selecting one of a plurality of bandpass filters (BPF's) having separate band-pass characteristics which collectively cover the bandwidth of all channels of the radio transmitter and thereafter coupling the RF signal through said selected one BPF for filtering and reducing broadband noise;

(c) an amplifier connected to said selected one BPF and operative to receive and amplify said filtered RF signal to a preselected level and outputting said amplified RF signal;

(d) means responsive to said outputted amplified RF signal for controlling the amplitude thereof in functional relation to said preselected level and a voltage

standing wave ratio (VSWR) load of the RF power amplifier.

7. The amplifier of claim 6, wherein said frequency determining means comprises:

(a) a coupler operative to provide a sample of the RF signal inputted into the amplifier;

(b) a counter connected to said coupler and responsive to said sample to produce a count representative of the frequency of the RF signal;

(c) an encoder responsive to said frequency count to produce a digitally encoded address signal;

(d) selection means for enabling an input and an output switch in response to said digitally encoded address signal for selecting said one BPF.

8. The amplifier of claim 7, wherein said selection means comprises:

(a) a decoder/driver connected to said encoder for receiving said digitally encoded address signal and selecting one of a plurality of select lines in response thereto, said decoder/driver operative to change the signal level present on said selected one select line; and

(b) one of a plurality of pin diode pairs, one diode of said pair connected to an input and the remaining diode of said pair connected to an output of said selected one BPF, each diode said one pin diode pair being forward biased when the signal level on said one select line is changed, said diode pair operative to provide a signal path for the RF signal through said one BPF.

9. The amplifier of claim 6, further including:

(a) first sample means proximate to the output of said amplifier and operative to sample said amplified RF signal and develop and output a first dc control signal functionally related to the signal level of said amplified RF signal;

(b) second sample means proximate to the output of said amplifier and operative to sample said amplified RF signal and develop and output a second dc control signal functionally related to the VSWR load reflected in said amplified RF signal;

(c) a source of a dc reference voltage;

(d) a differential amplifier having a first input connected to said dc reference voltage source and a second input connected to said dc control signal outputs of said first and second sample means, said differential amplifier operative to develop a differential control signal; and

(e) means responsive to said differential control signal for controlling the magnitude of said amplified RF signal at said preselected level in relation to the magnitude of said first dc control signal and reducing the magnitude of said amplified RF signal in relation to the magnitude of said second dc control signal.

10. The amplifier of claim 8, further including:

(a) first sample means proximate to the output of said amplifier and operative to sample said amplified RF signal and develop and output a first dc control signal functionally related to the signal level of said amplified RF signal;

(b) second sample means proximate to the output of said amplifier and operative to sample said amplified RF signal and develop and output a second dc control signal functionally related to the VSWR load reflected in said amplified RF signal;

(c) a source of a dc reference voltage;

(d) a differential amplifier having a first input connected to said dc reference voltage source and a second input connected to said dc control signal outputs of

said first and second sample means, said differential amplifier operative to develop a differential control signal; and

(e) means responsive to said differential control signal for controlling the magnitude of said amplified RF signal at said preselected level in relation to the magnitude said first dc control signal and reducing the magnitude of said amplified RF signal in relation to the magnitude of said second dc control signal.



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L3: Entry 12 of 16

File: USPT

Oct 9, 1984

DOCUMENT-IDENTIFIER: US 4476578 A

TITLE: Device for detecting the optimum anode load impedance of a tube transmitter in a high frequency transmission chain

Detailed Description Text (10):

Each of these rectifying filters 16 and 17 is followed by an amplifier (18 and 19) and the outputs of these two amplifiers 18 and 19 are connected to the input of an analog adder 20 which supplies at its output modulus matching detection data.

Detailed Description Text (15):

The phase matching detection means 13 also comprise a circuit 25 for calculating the mean value (more especially by HF filtering), having an input connected to the output of multiplier 24 and an output which supplies the phase matching detection data through an amplifier 26. The phase matching detection device 13 shown in FIG. 2 operates in the following way.

## CLAIMS:

1. A device for detecting the optimum anode load impedance of a transmitter tube in a high frequency transmitting chain, this transmitting chain comprising besides the tube, a transmitting antenna, the device comprising a variable impedance matching cell interposed between the tube and the transmitting antenna, said cell detecting said optimum anode load impedance of said tube, by detecting, from an input and an output voltage of said tube, during the variation of the impedance presented to said anode of said tube by said matching cell, a passing of said anode load impedance through a pre-determined purely resistive value; said cell comprising means for phase shifting by  $k(\pi/2)$  (with  $k$  being a positive or negative uneven integer) the phase difference between said input and output voltages of said tube, means for multiplying by each other the two voltages thus processed, and means for calculating the mean value of the product thus obtained, and for cancelling this mean value, during the variation of the impedance matching cell corresponding to the passing of the anode load impedance through a purely resistive value.

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L3: Entry 13 of 20

File: USPT

Aug 8, 2000

DOCUMENT-IDENTIFIER: US 6100843 A

TITLE: Adaptive antenna for use in same frequency networksParent Case Text (2):

This application is a continuation of U.S. patent application Ser. No. 09/157,736 filed Sep. 21, 1998 entitled "Method and Apparatus Providing an Adaptive Antenna For Use in Same Frequency Networks," the entire teachings of which are incorporated herein by reference.

Detailed Description Text (4):

It is also to be understood by those skilled in the art that FIG. 1 may be a standard cellular type communication system such as a CDMA, TDMA, GSM or other system in which the radio channels are assigned to carry data and/or voice or between the base stations 104 and subscriber units 101. In a preferred embodiment, FIG. 1 is a CDMA-like system, using code division multiplexing principles such as those defined in the IS-95B standards for the air interface.

Detailed Description Text (13):

To optimally set the phase shift for each phase shifter 111 through 115 in antenna 100, phase control values are provided by the controller 140. Generally, in the preferred embodiment, the controller 140 determines these optimum phase settings during idle periods when laptop computer 150 is neither transmitting nor receiving data via antenna 100. During this time, a received signal, for example, a forward link pilot signal 190, that is continuously sent from base station 160 and that is received on each antenna element 101 through 105. That is, during idle periods, the phase shifters 111 through 115 are adjusted to optimize reception of the pilot signal 190 from base station 160, such as by maximizing the received signal energy or other link quality metric.

Detailed Description Text (14):

The processor 140 thus determines an optimal phase setting for each antenna element 101 through 105 based on an optimized reception of a current pilot signal 190. The processor 140 then provides and sets the optimal phase for each adjustable phase shifter 111 through 115. When the antenna 100 enters an active mode for transmission or reception of signals between the base station 160 and the laptop 150, the phase setting of each phase shifter 111 through 115 remains as set during the previous idle time period.

Detailed Description Text (18):

FIG. 3 shows steps 301 through 306 performed by the controller 140 according to one embodiment of the invention. In order to determine the optimal phase settings for phase shifters 111 through 115 by the first "search" method, steps 301 through 306 are performed during idle periods of data reception or transmission, such as when a pilot signal 190 is being transmitted by the base station 160.

Detailed Description Text (21):

During long periods of idle time, step 308 is executed which repeats the process periodically. Step 308 accounts for the fact that the antenna 100 might be moved and re-oriented during idle periods, thus affecting the direction and orientation of the base station in relation to the antenna 100.

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L3: Entry 17 of 20

File: USPT

Jul 7, 1998

DOCUMENT-IDENTIFIER: US 5778308 A  
TITLE: Adaptive antenna matching

Abstract Text (1):

In a mobile radio telephone, an adaptive impedance matching circuit (25) is positioned between a transmitting power amplifier (24) and a duplexer (18). The adaptive matching circuit (25) matches an antenna (17) to associated electronic circuitry, thereby optimising power transfer in an effort to maintain communication with a base station and to minimise power dissipation within the device itself. An adaptation algorithm is selected and implemented during idle periods when a reflection coefficient is identified as being large. The reactance of a passive pi network is incrementally modified and settings which achieve an optimum match are stored for subsequent use.

Brief Summary Text (2):

The present invention relates to an adaptive antenna matching network, in which variations to antenna impedance are matched, so as to effect improved levels of power transfer.

Brief Summary Text (6):

It is accepted that, during normal operation, variations will occur to the actual operating impedance of the antenna. Thus, in order to overcome these variations in impedance, it is possible to provide an adaptive antenna matching network which compensates for these variations. A network of this type is disclosed in international patent publication number WO 88/05214. In accordance with this disclosure, a system monitors the signal strength of an incoming signal, primarily to provide a visual indication of signal strength as is well known in the art. In addition, this signal strength level is also used to adapt an adaptive network arranged to compensate for variations in antenna impedance. Thus, in accordance with the disclosure, if a reduction in signal strength is identified, it is assumed that this reduction is due to antenna mis-match and procedures are implemented in order to improve the matching characteristics of the antenna.

Brief Summary Text (9):

It is an object of the present invention to provide an improved adaptive antenna matching network.

Brief Summary Text (10):

According to an aspect of the present invention, there is provided an adaptive antenna matching network in which the impedance of said matching network is adjusted in response to the operating environment of the antenna comprising means for directly measuring the level of reflected signals and means responsive thereto for adjusting the impedance of the matching network.

Drawing Description Text (4):

FIG. 2 details circuitry within the mobile telephone shown in FIG. 1, including an adaptive antenna matching network;

Drawing Description Text (5):

FIGS. 3A-3C detail examples of the adaptive antenna matching circuits shown in FIG. 2, each including a matching network;

Detailed Description Text (2):

A radio cellular telephone unit 15 is shown in FIG. 1 communicating with a base station 16. The radio telephone unit is of a TDMA type, wherein data is transmitted

during allotted time slots. Furthermore, idle periods are available, during which the telephone is neither transmitting nor receiving.

Detailed Description Text (3):

The telephone unit is arranged to communicate with one of a plurality of base stations, such as base station 16, depending upon its geographical location. Furthermore, during said idle time, the telephone will investigate whether it can obtain improved communication with another base station, usually due to a telephone unit being moved into an adjacent cell, whereupon communication with the previous base station will be terminated and reinstated with the base station providing clearer transmission characteristics.

Detailed Description Text (5):

The radio telephone unit 15 shown in FIG. 1 is detailed in FIG. 2. Antenna 17 is connected to a duplexing circuit 18, essentially containing a first band pass filter 19 and a second band pass filter 20. Signals received by the antenna 17 are allowed to pass through band pass filter 19 and are, in turn, supplied to an input processing circuit 21 via an input amplifier 22. Similarly, an output circuit 23 generates signals which are supplied to the antenna 17, via an output power amplifier 24, an adaptive antenna matching network 25 and the output band pass filter 20.

Detailed Description Text (6):

In this embodiment, antenna matching is effected by considering signals which are being transmitted by the radio telephone. In alternative embodiments, the adaptive antenna matching network or an additional matching network, could be provided between input band pass filter 19 and input amplifier 22. However, it should be appreciated that significantly higher signal levels are available in the transmission path, in preference to the reception path. In another alternative embodiment, the adaptive antenna matching circuit 25 may be provided between the antenna 17 and the duplexer 18, allowing adaptation to be effected in response to both transmitted and received signals. However, as previously stated, in the preferred embodiment detailed subsequently, the adaptive antenna matching network 25 is provided between the output amplifier 24 and the duplexer 18.

Detailed Description Text (7):

The adaptive antenna matching network 25 is detailed in FIG. 3A. Impedance matching is effected by means of an adaptable passive matching network 31 of passive, variable-reactance components, which is adapted in response to signals received from a digital processor 32. Output signals from the output power amplifier 24 are supplied to the matching circuit 31 via a coupler 33, arranged to direct a proportion of said signals to processor 32, via a detector 34 and an analog-to-digital converter 35. Detector 34 essentially consists of a diode and is arranged to generate a voltage proportional to the power of the signal received from the coupler 33. This voltage is in turn supplied to the analog to digital converter 35, arranged to supply a digital representation of said voltage to the processor 32. Thus, the coupler 33, the detector 34 and the analog-to-digital converter 35 provide a digital indication to the processor 32 of the power of the forward transmission signals supplied to the antenna. As the radio telephone typically determines the transmission level a digital indication of the transmission level could be provided without direct measurement being necessary.

Detailed Description Text (16):

The operation of the circuit shown in FIG. 4 during adaptation is illustrated in FIGS. 5a, 5b, 5c and 5d. In the preferred embodiment, adaptations are made during idle periods, so that impedance values which result in a mismatch being made worse will not actually affect transmission characteristics. In alternative embodiments where transmission occurs continuously, for example in analog systems, modifications may be made extremely quickly, thereby not effecting transmission to a noticeable degree or, alternatively, modifications may be made over a limited range so as to minimise detrimental effects.

Detailed Description Text (17):

In the preferred embodiment, it is not necessary to effect the adaptation algorithm during each idle period. For example, the adaptation algorithm may be called once

every 0.5 seconds or after whatever other interval is found to be appropriate. An advantage of this approach is that idle periods may be used for other functions, under the control of suitable processor software.

Detailed Description Text (27):

Thus, it can be appreciated that during the adaptation process, all possible values are considered and in many occurrences, the actual matching of the antenna to its associated circuitry will be made a great deal worse than that before the adaptation process was commenced. However, given that this adaptation occurs during the idle periods, this does not adversely affect overall transmission characteristics. At each stage, the reflection coefficient is compared with the "best so far" value and if a better value is found for the control signals, the registers are overwritten with these said values. Thus, after completing the adaptation algorithm, the best possible settings for the control signals will have been determined, whereafter they will be automatically read from the registers and selected as the new values for application to the control ports during the transmission and reception periods.

CLAIMS:

1. An adaptive antenna-matching network for a radiotelephone, said network comprising;

first and second reactive circuits interconnected by a third reactive circuit, wherein each of said first and said second reactive circuits comprises a shunt element, and said third reactive circuit comprises a series reactance operative for reversal between capacitive and inductive values of reactance;

means responsive to the operating environment of the radiotelephone for directly measuring the level of reflected signals produced by the radio telephone's environment;

means responsive to said level of reflected signals for electronically adjusting the impedances of individual ones of said reactive circuits of the matching network;

wherein said measuring means and said adjusting means are operative to effect repetitive measurements of the reflected signals and repetitive adjustments of the impedance.

2. An adaptive antenna-matching network according to claim 1, wherein said matching network is adjusted in response to the level of transmitted signals relative to said level of reflected signals.

4. An adaptive antenna-matching network according to claim 1, wherein said matching network is also adjusted in response to a direct measurement of the level of transmitted signals.

5. An adaptive antenna-matching network according to claim 1 wherein the means for adjusting is responsive to an indication that the reflected signals meet predetermined level criteria.

6. An adaptive antenna-matching network according to claim 5 wherein the means for adjusting comprises means for comparing the impedance match obtained by an adjustment with a previously recorded best impedance match, if the adjusted impedance match is better, the recorded best impedance match is replaced with the adjusted match.

7. An adaptive antenna-matching network according to claim 6 wherein the impedance match reverts to the recorded best impedance match between adjustments.

16. An adaptive antenna-matching network according to claim 1 wherein said measuring means and said adjusting means are operative to effect said repetitive measurements of the reflected signals and said repetitive adjustments of the impedance during intervals of a radiotelephonic communication.

17. An adaptive antenna-matching network according to claim 16 wherein said

intervals of a radiotelephonic communication are idle periods.

24. An adaptive antenna-matching network for a radiotelephone, said network comprising:

first and second reactive circuits interconnected by a third reactive circuit, wherein each of said first and said second reactive circuits comprises a shunt element, and said third reactive circuit comprises a series reactance operative for reversal between capacitive and inductive values of reactance;

means responsive to the operating environment of the radiotelephone for directly measuring the level of reflected signals produced by the radio telephone's environment;

means responsive to said level of reflected signals for electronically adjusting the impedances of individual ones of said reactive circuits of the matching network.

25. An adaptive antenna-matching network for a radiotelephone, said network comprising:

a first reactive circuit having a shunt reactance and a second reactive circuit having a series reactance, said shunt reactance having a frequency-selectable resonance, and said series reactance being operative for reversal between capacitive and inductive values of reactance;

means responsive to the operating environment of the radiotelephone for directly measuring the level of reflected signals produced by the radio telephone's environment; and

means responsive to said level of reflected signals for electronically adjusting the impedances of individual ones of said reactive circuits of the matching network.

26. An adaptive antenna-matching network for a radiotelephone, said network comprising:

first and second reactive circuits interconnected by a third reactive circuit, wherein each of said first and said second reactive circuits comprise a shunt reactance, and said third reactive circuit comprises a series reactance, one of said first and said second reactance circuits being operative to become transparent to a signal propagating through said antenna-matching network;

means responsive to the operating environment of the radiotelephone for directly measuring the level of reflected signals produced by the radio telephone's environment; and

means responsive to said level of reflected signals for electronically adjusting the impedances of individual ones of said reactive circuits of the matching network.